

THE MINERAL INDUSTRY OF THAILAND

By John C. Wu

Thailand, which is located north of the Andaman Sea and the Gulf of Thailand, east of Burma, west of Cambodia and Laos, and north of Malaysia in Southeast Asia, was classified as a lower- to middle-income developing country by the World Bank. The country had a population of about 65.4 million. Its total area is about 514,000 square kilometers. In 2004, Thailand's gross domestic product (GDP) and per capita GDP based on purchasing power parity were estimated to be \$512.3 billion and \$7,900, respectively (World Bank, 2004¹; International Monetary Fund, 2005²; U.S. Central Intelligence Agency, 2005³).

Thailand's identified mineral resources are antimony, ball clay, barite, bentonite, copper, diatomite, dolomite, feldspar, fluorite, gold, gypsum, iron ore, kaolin, lead, limestone, manganese, marl, phosphate rock, potash, quartz, rock salt, silica sand, tin, tungsten, and zinc (Department of Mineral Resources, 1998, p. 18). Thailand also has small resources of coal, natural gas, and crude petroleum.

Resources of such industrial minerals as diatomite, dolomite, gypsum, kaolin, limestone, marl, potash, and silica sand were more abundant than other identified minerals. The resources of barite, copper, fluorite, gold, gypsum, iron ore, lead, quartz, potash, tin, tungsten, and zinc, however, have higher economic unit value. During the past 20 years, most of the identified minerals except copper and potash have been exploited for domestic consumption and export.

In 2004, Thailand was one of the world's top producers of feldspar and gypsum. Thailand also was one of the world's leading exporters of cement, feldspar, and gypsum. The mineral production of barite, coal (lignite), dolomite, feldspar, natural gas, gemstones, gold, gypsum, kaolin, limestone, crude petroleum, rock salt, silica sand, tin, tungsten, and zinc was important to the Thai economy. Some of these minerals, however, were exported to earn foreign currency. The leading export minerals were feldspar, gypsum, tin metal, tantalum powder, and zinc metal. Thailand imported such ferrous and nonferrous metals as primary aluminum, refined copper, refined lead, iron and steel, and precious metals; and such mineral fuels as bituminous coal, natural gas, and crude petroleum to meet its domestic requirements.

According to the National Economic and Social Development Board, the output of the mining and quarrying sector grew by 4.9% in 2004 compared with 6.8% in 2003. In 2004, the output value of the mining and quarrying sector, which was estimated to be \$2 billion in 1988 constant dollars, contributed about 2.2% to the country's GDP and its workforce accounted for about 3% of the total labor force. The continued growth in the mining and quarrying sector was the result of increased production of such mineral fuels as lignite and natural gas, such metallic minerals as iron ore and zinc ore, and such industrial minerals as barite, dolomite, feldspar, gypsum, limestone, pyrophyllite, rock salt, and talc. The Thai economy, as measured by the GDP, grew by 6.1% in 2004 compared with 6.7% in 2003. The Thai GDP, in 1988 constant dollars, was estimated to be \$91 billion in 2004 compared with \$83 billion in 2003. The Thai total labor force increased to 35.8 million in 2004 from 34.9 million in 2003, and the rate of unemployment remained unchanged at 2.0% in 2004. The inflation rate, as measured by change in the Consumer Price Index, rose to 2.7% from 1.8% in 2003. The country's merchandise trade surplus dropped to \$1.7 billion in 2004 from \$3.8 billion in 2003 as a result of a 27% surge in imports compared with a smaller (23%) increase in exports. The country's total outstanding debt decreased slightly to \$51.3 billion from \$51.8 billion in 2003 (Bank of Thailand, 2004a⁴).

Government Policies and Programs

Thailand's mineral resources are owned by the State. Mineral exploration and development are governed by the Minerals Act of 1967, the Minerals Royalty Act No. 4 of 1966, and the Tin Control Act of 1977. The Minerals Act of 1967, which had been amended in 1973, 1979, and 1991, was amended again by Minerals Act No. 5 in 2002 for underground mining; the new amendment permits mining at depths of greater than 100 meters (m) below the surface without requiring the specific consent of the holder of the surface right. The Minerals Act governs onshore and offshore exploration, mineral production, mineral trade, ore dressing, transport, and export of minerals other than petroleum. The Minerals Royalty Act prescribes the rates of royalties to be assessed for different kinds of minerals. The Tin Control Act controls the mining and trade of tin.

Under the Minerals Act of 1967, the Ministry of Industry was appointed as the principal Government agency to regulate the mining sector. Under the Ministry, the Primary Industry and Mines Department (PI&MD) is empowered to administer the Minerals Act and to issue ministerial regulations, and the Department of Mineral Resources (DMR) is empowered to set national mineral and geological policies. The PI&MD also provides technical assistance in mining, mineral processing, and metallurgical activities under the jurisdiction of the Ministry of Industry; the DMR provides technical assistance in geologic prospecting and mineral exploration under the jurisdiction of the Ministry of Natural Resources and Environment (Department of Mineral Resources, 2004⁵).

Environmental Issues

In response to concerns about the cadmium contamination problem in the vicinity of Mae Tao Creek in the Mae Sot District of Tak Province and to subsequent news reports in the media, Padaeng Industry Public Co. Ltd. (PDI) reportedly commissioned the National Research Center for Environmental and Hazardous Waste Management at Chulalongkorn University to conduct a research study to find sustainable and systematic ways to solve the problem. The company expected findings of the study to be completed by early

¹References that include a section mark (§) are found in the Internet References Cited section.

2005, and the result of the study would be presented to relevant Government agencies as their recommendation for resolving the problems. In addition, the company has a budget of \$74,400 (3 million baht) per year to assist local citizens in the area of health, standard of living, and livelihood (Padaeng Industry Public Co. Ltd., 2005\$).

Production

In 2004, Thailand's minerals production included barite, coal, dolomite, feldspar, natural gas, gemstones, gypsum, kaolin, limestone, crude petroleum, rock salt, silica, tin, tungsten, and zinc. The main processed mineral products were cement, fluorite (metallurgical grade), refined petroleum products, steel, refined tin, and refined zinc. Thailand also produced tantalum metal powder and oxides, which were produced from tantalum-bearing scrap and tin slag purchased from domestic and foreign sources.

In 2004, production of most industrial minerals except marble, phosphate rock, quartz, and silica sand increased. Production of metals except silver, tin, and tungsten increased considerably. In 2004, production of mineral fuels except crude petroleum increased. Production of cement, refined petroleum products, steel, refined tin metal, and refined zinc metal increased (table 1).

Trade

Exports rose by 23% to \$96.1 billion in 2004 from \$78.1 billion in 2003; imports rose by 27% to \$94.4 billion in 2004 from \$74.3 billion in 2003. Thailand's merchandise trade surplus shrank to \$1.7 billion in 2004 from \$3.8 billion in 2003. As a result, the Thai baht lost 1.2 baht against the U.S. dollar, which was a decrease of 2.9%, falling to 40.3 baht against US\$1.00 in 2004 compared with 41.5 baht in 2003. Japan and the United States were the two major trade partners of Thailand and accounted for 18.7% and 11.8%, respectively, of total two-way merchandise trade in 2004 (Bank of Thailand, 2004b\$).

Thailand was a net importer of mineral commodities mainly because of its large import bills for coal, iron and steel products, nonferrous metals, and crude petroleum. According to Thailand's Customs Department, exports of major crude and intermediate mineral products totaled \$1.26 billion in 2004, of which refined tin was valued at \$116 million; gypsum, \$66 million; and all other mineral products, \$1.07 billion. Exports of major processed mineral commodities were base-metal products, which included iron and steel, \$3.9 billion; refined petroleum products, \$2.6 billion; and precious stones and jewelry, \$2.3 billion (Bank of Thailand, 2004a\$).

In 2004, imports of major mineral fuel commodities were as follows: crude petroleum, \$10.7 billion; refined petroleum products (lubricant and asphalt), \$2.2 billion; coal, \$304.6 million; and coke and briquette, \$304 million. Imports of major nonfuel mineral products were as follows: iron and steel products, \$5.8 billion; other base metal products, \$2.4 billion; jewelry and silver bar, \$1.8 billion; and fertilizers and pesticides, \$1.1 billion (Bank of Thailand, 2004b\$).

Commodity Review

Metals

Copper.—In June, Pan Australian Resources N.L. (PAR) of Australia announced that the Cabinet of the Thai Government had approved a proposal for a full feasibility study and had given approval in principle for mining at the Puthep copper project, which is located about 20 kilometers (km) southeast of Loei in northern Thailand. Before the Government approval, work had been suspended on the project because of land access restrictions imposed as a consequence of the Government's watershed zoning over the PUT 1 deposit, which is Thailand's largest known copper deposit. By December, PAR and its joint-venture partner PDI reportedly concluded an agreement with Thai Government officials on a set of conditions to be applied to the feasibility study's drilling program. PAR had approved a budget to begin the first phase of the drilling program but was still waiting for the Government's final approval to start. According to an earlier prefeasibility study, the PUT 1 deposit had the potential to become a viable copper mine that could produce more than 25,000 metric tons per year (t/yr) of copper cathode by heap leach and solvent extraction-electrowinning from a 7-million-metric-ton-per year (Mt/yr) throughput rate. The preproduction development capital was estimated to be \$70 million, and operating costs were estimated to be about \$0.51 per pound. The total indicated and inferred mineral resources at the PUT 1 and nearby PUT 2 deposits were estimated to be 121 million metric tons (Mt) at a grade of 0.43% copper (Pan Australian Resources N.L., 2004a\$, b\$).

In 2004, Thailand became a producer of refined copper for the first time. Thai Copper Industries plc., which suspended construction of its 165,000-t/yr copper smelter and refinery in Rayong Province in eastern Thailand in March 1998, completed construction of the smelter and refinery in 2004. In January 2003, the \$115 million construction contract was awarded to Aker Kvaerner OGEP of Norway to complete the project. The \$580 million copper smelter and refinery complex is located at Rayong Industrial Park in Rayong Province and was initially scheduled to be commissioned by April 2004. Through its affiliates Kvaerner E&C (Thailand) Ltd. and Kvaerner U.S. Inc., Aker Kvaerner was responsible for the project and completed the Thai Copper project on May 6, 2004 (Aker Kvaerner OGEP, 2004\$).

The smelter/refinery complex in Rayong Province reportedly began operations on September 24, 2004, with an initial capacity of 72,000 t/yr of copper cathode; the company planned to double the capacity to 165,000 t/yr in 2005. According to the officials of Thai Copper, the company planned to start negotiating with BHP Billiton Ltd. of Australia and Corporación Nacional del Cobre de Chile to secure the long-term supply of 90% of the smelter's raw material requirement (copper concentrates) and to purchase the remaining 10% from the spot market. The smelter's stockpile of 120 000 metric tons (t) of copper concentrates, which was imported mainly from Australia and Chile in 2004, was expected to run out during the first quarter of 2005 (Business Day, 2004a\$, b\$; Metalworld.com, 2005\$).

According to the International Copper Study Group (2005), Thai Copper produced about 20,000 t of copper cathode in 2004.

Gold.—Kingsgate Consolidated N.L. of Australia, through its 90% owned subsidiary Akara Mining Ltd., produced gold from the Chatree Mine, which is located 45 km southeast of the provincial capital of Phichit on the border of Petchabun and Phichit Provinces. According to Kingsgate Consolidated, for the financial year 2004 that ended on June 30, 2005, production of gold decreased by 15.6% to 3,936 kilograms (kg) (126,550 troy ounces) from 4,665 kg (149,979 troy ounces) for financial year 2003. The lower gold production in fiscal year 2004 was a result of lower grade ore with a higher ratio of waste to ore. In July, the company completed construction of a second mill, which would enable the gold mine to process up to 1.8 Mt/yr of ore compared with 1.32 Mt/yr in fiscal year 2004. As a result, Kingsgate Consolidated expected to raise the production of mined gold in financial year 2005 to between 4,510 kg (145,000 troy ounces) and 4,666 kg (150,000 troy ounces) (Thaipro.com, 2004§; Mineweb.net, 2005§).

In 2004, a grade-control drilling program in the Tawan Pit at the Chatree Mine reportedly discovered an ore zone with high gold grades. According to Kingsgate Consolidated, this high-grade zone is located within the mining lease in the recently discovered extension to the H ore body. The zone, which has many intersections and contains more than 100 grams per metric ton gold, is about 75 m long, 20 m wide, and at least 10 m deep. The discovery of this high-grade gold zone confirmed the potential for the deposit to host higher grade gold zones (Minebox.com, 2004§).

Iron and Steel.—Iron ore production rebounded to 135,580 t from 9,675 t in 2003. Thailand continued to rely heavily on imports of ferroalloys, pig iron, steel scrap, and crude steel (billet, slab, and ingots) to meet the requirements of its steel sector.

In 2004, Thailand's crude steel production increased by 27% to 4.53 Mt from 3.57 Mt in 2003 (Southeast Asia Iron and Steel Institute, 2005§). Thailand's crude steel was produced by electric arc furnaces, which used mostly imported iron and steel scrap.

In July 2004, the Ministry of Industry reportedly commissioned the Iron and Steel Institute of Thailand to conduct a feasibility study on the prospects for a major development of new iron-reduction plant capacity in Thailand. According to a senior official, two possibilities were being investigated—a plant with the capacity of from 1 to 2 Mt/yr on the eastern seaboard or a plant with the capacity of from 4 to 5 Mt/yr in Prachuap Khiri Khan Province where Thailand's leading producer of hot-rolled steel coil, Sahaviriya Steel Industry Co. Ltd., was located. The prospects for going upstream are limited because of China's ability to build low-cost facilities and its expanding iron-reduction capacity (Southeast Asia Iron and Steel Institute, 2004c§).

In September 2004, however, Sahaviriya Steel announced plans to launch a \$12.4 billion ironmaking and steelmaking project that would have a final capacity of 30 Mt/yr. The project, which will comprise five phases during a period of 15 years, would be located at its steel complex in the Bang Saphan District, Prachuap Khiri Khan Province. According to Sahaviriya Steel, upon completion, the project would make Thailand a major steel exporter rather than a net steel importer. The Sahaviriya Group Corp. Ltd. had invested more than \$1.7 billion to set up 23 steel-processing plants in Bang Pakong, Bang Saphan, and Prapadaeng. Beginning in 2005, the Group would have a combined total rolling capacity of 7.6 Mt/yr, of which Sahaviriya Steel would have the capacity to produce 4 Mt/yr of hot-rolled coil; Sahaviriya Plate Mill, 1 Mt/yr of heavy plate; Sahaviriya Sahap Steel and Bang Saphan Bar Mill, 1 Mt/yr each of sections and rebar; and BP Wire Rod, 600,000 t/yr of steel products (Southeast Asia Iron and Steel Institute, 2004d§).

In November 2004, Sahaviriya Steel announced that it expected its sales to increase by 45% to \$1.24 billion in 2005 because of its plant expansion. The company planned to start production at a new plant in Prachuap Khiri Khan Province in February 2005. The capacity of the new plant would be 4 Mt/yr of rolled steel compared with 2.4 Mt/yr in 2004 (Southeast Asia Iron and Steel Institute, 2004b§).

In August 2004, Natsteel Ltd. signed a definitive equity share subscription (sell/purchase) agreement with Tata Iron and Steel Co. Ltd. of India to sell its steel business to Tata Iron and Steel in an all-cash deal for \$285 million. Natsteel planned to use the money from the sale to expand its chemicals and construction businesses. The acquisition would give Tata Iron and Steel a presence in China, the Philippines, Thailand, and Vietnam (Southeast Asia Iron and Steel Institute, 2004a§).

Lead.—An economic analysis of lead mining in Kanchanaburi Province, which was funded by the DMR, was completed in December 2003. The purpose of the study was to examine the economic justification for isolating part of the forest reserves in Kanchanaburi Province as an economic zone designed for mining operations. To justify such zoning, the benefit of mining was weighed against its social costs. One of the social costs that had been focused on in the study was the impact on health.

The major findings of the study were as follows: the health impact and other environmental impacts of lead mining at Klitty village can be minimized by proper management, and the economic feasibility of lead mining shows a small net social return owing mainly to declining world lead prices during the study period. The study, however, recommended that lead mining might continue at the Song-Tor Mine site, but not at the Bor-Wgam Mine site; and that proper economic zoning of lead and other mineral resources should be carried out to prevent future impacts on health from improper land use (Thailand Development Research Institute, 2003§).

Tin.—In 2004, production of tin continued its 2002 downward trend and reached a record low of 724 t of tin in concentrate. To meet its tin smelter's raw material requirement, Thailand imported 12,753 t of tin concentrate from Australia, Bolivia, Laos, Peru, and Portugal. Production of refined tin by Thailand Smelting and Refining Co. Ltd. (Thaisarco), however, increased by 35% to 20,800 t. Reports on the impact of the December 2004 tsunami on tin in southern Thailand were not available. Production of tin could be lower in 2005. The impact report of the tsunami on the production of refined tin at the Thaisarco's tin smelter on Phuket Island was also not available. Metal production could be maintained at the same level if the plant facilities were not severely damaged by the tsunami. Thaisarco produced regular refined tin metals, Thaisarco brand tin with 99.85% tin and low-lead tin metals with 50 or 100 parts per million lead, tin-lead and lead-free solders, tin alloys, pewters, and tin powders. In 2004, Thailand exported refined tin mainly to the Netherlands (46%), Japan (28%), the Republic of Korea (3%), and Belgium (2%) (World Bureau of Metal Statistics, 2005, p. 127; Thailand Smelting and Refining Co. Ltd., 2005§).

Zinc.—Zinc silicate ore produced mainly from the Mae Sot Mine by PDI totaled 167,024 t in 2004 compared with 249,539 t in 2003. The average metal content of zinc silicate ore produced was 26% zinc in 2004 compared with 25% zinc in 2003. According to PDI, a full-scale flotation plant, which upgraded the low-grade ores to concentrates, was commissioned next to the existing flotation plant. The new flotation plant would increase production of concentrate by as much as 97,000 t. The Mae Sot Mine had been in

operation for 21 years. The remaining ore reserves were estimated to be 3.6 Mt at a grade of 12.7% zinc (Padaeng Industry Public Company Ltd., 2005§).

In 2004, PDI smelter in Tak, which is located 96 km from the Padaeng Mine, received 185,537 t of zinc concentrate from the Mae Sot Mine. In addition, PDI imported a total of about 106,000 t of zinc concentrate (zinc sulfide) at a higher cost than the previous year from Australia, North America, and South America because of lower levels of worldwide ore production. PDI also purchased a small amount of silicate ore and oxide raw materials from such neighboring countries as Burma and Laos (Padaeng Industry Public Co. Ltd., 2005§).

PDI's zinc smelter in Tak produced 108,577 t of cathode zinc, which was about 95% of its total capacity of 115,000 t/yr. The overall production of zinc metal was 115,112 t, of which 68,285 t was SHG products (zinc ingot) and 46,827 t, alloys. In 2004, PDI extended its range of zinc alloys production by starting to produce alloy with high aluminum content (up to 10%) for the galvanizing industry (Padaeng Industry Public Co. Ltd., 2005§).

Industrial Minerals

Cement.—The continued growth in domestic demand for cement by the construction industry for housing projects, which grew by about 7.3% in 2004, had resulted in a 9.5% increase in cement production to 35.6 Mt and a 4.4% increase in clinker production to 35.1 Mt in 2004. This growth was largely the result of Government policies that stimulated housing demand. Some of the growth momentum was lost when tax incentives for home buyers expired in the first quarter of 2004, and housing loans become harder to get. According to a Thai industry analyst, the building materials industry, however, was expected to maintain growth of 10% until 2005 (Bangkok Post, 2005§).

In 2004, the cement industry's production capacity remained the same as in 2003 at about 54 Mt/yr. According to Siam Cement Industry Co. Ltd, domestic demand was estimated to be around 26 Mt in 2004. Thai demand for cement was expected to continue growing at between 10% and 11% to about 28 Mt in 2005 because of public infrastructure spending that included transport projects and expansion of power generation capacity (International Cement Review, 2005; Bangkok Post, 2005§). According to the Thai Customs Department, exports of cement decreased slightly to 11.9 Mt in 2004 from 12.2 Mt in 2003 and 17.7 Mt in 2002 (Bank of Thailand, 2004b§).

In early 2004, eight Thai cement producers reached an agreement to cut their exports to zero gradually within the next 5 years after the Prime Minister expressed concern about the industry's impact on the environment. The Government expressed confidence that Thai cement producers would be able to reduce exports as planned and that the lost revenue could be offset by rising demand from the recovering real estate sector (International Cement Review, 2004a).

Siam Cement, which maintained its leading position in the Thai cement industry, operated at about 80% of its capacity of 23.2 Mt/yr in 2004. The company exported 6 Mt of cement and planned to export 7 Mt in 2005. In June 2004, the company announced that it planned to expand capacity for dry mortar by 200,000 t in mid-2005. The planned expansion was in response to growing demand in the Thai cement market (Siam Cement Group, 2005§).

Siam City Cement Public Co. Ltd., which was Thailand's second ranked cement producer, operated at 76% of its capacity of 14.5 Mt/yr and maintained its 28% domestic market share in 2004. The company sold 10.4 Mt of cement in 2004, of which 7.1 Mt was for domestic sales, and made a net profit of \$108 million because of higher domestic sales. The company was expected to operate at full capacity in 2005 (International Cement Review, 2005).

TPI Polene Co. Ltd., which was Thailand's third ranked cement producer and had 18% of the domestic market share, announced that it planned to spend about \$148.9 million (6 billion baht) to expand its cement production capacity by 3.3 Mt/yr to 13.2 Mt/yr because of increasing demand for cement owing to the Government's infrastructure and utilities development projects. According to the company's plan, the capacity expansion project would be completed by the end of 2005 (International Cement Review, 2004b).

Feldspar.—Thailand was one of the world's leading producers of sodium feldspar. The country also produced a small amount of potassium feldspar. In 2004, overall production of feldspar reached more than 1 Mt for the first time. A small amount of potassium feldspar was produced from the Provinces of Kanchanaburi, Prachuap Khiri Khan, and Ratchaburi in the Central Region. Sodium feldspar was produced mainly from Tak Province in the Northern Region and from the Provinces of Nakhon Si Thammarat and Trang in the Southern Region. Thai feldspar was exported mostly to such Asian countries as Indonesia, Japan, Malaysia, the Philippines, Taiwan, and Vietnam. The United Arab Emirates was the major importer of Thai feldspar outside of Asia and the Pacific region. Asia Mineral Processing Co. Ltd. (AMPC), which was Thailand's leading producer of feldspar, was the leading producer and distributor of feldspar products in Southeast Asia. AMPC produced various grades of potassium feldspar, sodium feldspar, and mixed products from open pit mines in seven concessions in the Provinces of Nakhon Si Thammarat and Trang. The Amphoe Tha Sala and the King Amphoe Nob Phi Tam areas contain a total of more than 1.5 Mt of ore reserves, which accounted for about 1.5% of the country's total estimated feldspar reserves of 100 Mt (Department of Mineral Resources, 1998, p. 18). AMPC processing facilities are located in the Province of Trang near the Port of Kantang along the Andaman Sea and in the Province of Nakhon Si Thammarat near the Port of Tha Sala along the Gulf of Thailand (Asia Mineral Processing Co. Ltd., 2005§).

Potash.—In November 2004, Asia Pacific Resources Ltd. (APR) applied for a mining lease for the majority of the land originally held under the Special Prospecting Licenses that contained all the Udonthani project areas where previous exploration by drilling and seismic work identified potash resources. APR indicated that this mining lease application had been duly registered by the Government and that the Government had advised the company that it has first priority under the terms of its concession agreement with the Government. In May 2003, APR submitted an application for four mining leases for the mining area that covers the potash deposits in Udonthani South, and the Government reportedly began processing the application upon completion of the revised

regulations early in 2004. APR was hoping that the mining lease for the Udon South deposit would be granted in 2005 (Asia Pacific Resources Ltd., 2004\$).

The Udon South deposit was estimated to contain a potash resource of 302 Mt at a grade of 23.5% potassium oxide (K_2O). The measured and indicated resources totaled about 30 Mt at a grade of 26.8% K_2O within a high-value core area that averaged 7.2 m in thickness. The Udon North deposit was estimated to contain 665 Mt of potash resources, of which 175 Mt was indicated resource at a grade of 19.0% K_2O and an average thickness of 12 m and 490 Mt inferred resource at a grade of 16.5% K_2O and an average thickness of 12 m (Asia Pacific Resources Ltd., 2005a\$, b\$).

Mineral Fuels

Coal.—Thailand was an important coal producer in Asia and the Pacific region. Its coal production, however, could not meet Thailand's demand by its cement, electric utility, and iron and steel industries. In 2004, coal (lignite) production increased by 6.5% to 20.1 Mt from 18.8 Mt in 2003. The state-owned Electricity Generating Authority of Thailand (EGAT), which operated the Mae Moh Mines in the Province of Lampang, produced about 16.68 Mt (Electricity Generating Authority of Thailand, 2004\$). The remaining 3.4 Mt was produced by EGAT, Banpu Mineral Co. Ltd., and Chiang Muan Mining Co. Ltd., which operated coal mines in the Provinces of Lampang, Lamphum, and Phayao. To meet the overall coal demand, Thailand imported 7.6 Mt of coal, which was valued at \$204.6 million in 2004. Of that total, bituminous coal accounted for 7.1 Mt compared with 6.5 Mt imported in 2003; anthracite, 355,130 t compared with 532,860 t imported in 2003; and coking coal, 66,390 t compared with 64,750 t imported in 2003 (Energy Policy and Planning Office, 2005c\$).

An environmental impact assessment (EIA) for the proposed development of lignite resources at Wiang Haeng District in the Province of Chiang Mai had been conducted by EGAT, which was permitted to develop the coal basin without a bidding process provided that the project's EIA was approved by the Government. In May 2004, Chiang Mai University was appointed to conduct the EIA for the project; the process would include a public participation component to allow the local community to participate in the environmental impact study, which was scheduled to be completed in mid-2005. The Wiang Haeng Basin was estimated to contain about 139 Mt of high-quality coal reserves suitable for electricity generation, which EGAT planned to mine to supplement the lignite fuel for the Mae Moh powerplant in the Province of Lampang (Electricity Generation Authority of Thailand, 2004\$).

Consumption of domestically produced lignite totaled 20.5 Mt in 2004, of which 16.5 Mt was consumed by EGAT in power generation at the 2,625-megawatt Mae Moh lignite-fired powerplant and 3.9 Mt was consumed as energy by the manufacturers of cement, fiber, lime, and paper; tobacco curers; and other users. Imported coal (mostly anthracite, bituminous, and coking coal), which totaled 7.6 Mt, was consumed mainly by the manufacturers of cement and ferrous and nonferrous metals (Energy Policy and Planning Office, 2005c\$).

Natural Gas and Petroleum.—Thailand's natural gas production increased by 3.2% to an average of 61.3 million cubic meters per day in 2004 from an average of 59.4 million cubic meters per day in 2003 owing mainly to a 36% increase in output from the Bong Kot and the Pailin Gasfields. In 2004, natural gas was produced from 20 gasfields, most of which were offshore. About 54.5% of Thailand's natural gas was produced by Unocal Thailand Ltd. (UT) from offshore gas and condensate fields (Baanpot; Erawan; Funan; Gomin; Jakarawan; Kaphong, which was brought onstream by UT in early 2004; Pailin; Platong; Satun; South Satun; and Trat); the remaining 45.5% was produced by PTT Exploration and Production (PTTEP) [a wholly owned subsidiary of the state-owned Petroleum Authority of Thailand (PTT)], ChevronTexaco Corp., and other companies, from offshore gasfields (Benjamas, Bong Kot, Plamuk, Plandaeng, Surat Thani, Tantawan, and Yala) and onshore gasfields (Nam Phong and Sirikit) (Energy Policy and Planning Office, 2004b\$).

UT, which was Thailand's leading gas producer, operated 100 platforms in the central Gulf of Thailand. UT supplied 75% of its natural gas output to meet 33% of Thailand's power generation requirement and 25% to meet fuel requirements for the manufacturing and transportation industries, for household cooking, and as feedstock for petrochemicals. In late 2004, UT announced a plan for an extensive drilling program in the Gulf of Thailand to meet expected higher demand for gas, when PTT completed a third pipeline from gasfields in the Gulf of Thailand to onshore facilities in 2006. Under the plan, UT intended to drill between 30 and 45 wells on its four offshore contract areas between 2005 and 2007. The company also planned to bring the South Gomin Gasfield onstream in late 2006. The South Gomin Gasfield project was 71.25% owned by UT; 23.75%, by Mitsui Oil Exploration; and 5%, by PTT (Petroleum Economist, 2004b).

In December 2003, a share-purchase agreement was reached between PTTEP and its subsidiary PTTEP Offshore Investment Co. Ltd. and Thai Shell Exploration and Production Co. Ltd. (Thai Shell), which was the Thai upstream unit of Royal Dutch/Shell plc, for the entire issued equity share of Thai Shell for about \$205 million. The asset, which included the onshore S1 block (75% owned by Shell and 25%, by PTTEP), the offshore B6/27 block (100% owned by Thai Shell) in the Gulf of Thailand, and the onshore L22/43 block (65% owned by Thai Shell and 35%, by PTTEP) was valued by Thai Shell at \$1 billion (Petroleum Economist, 2004a; Platts.com, 2003\$).

Production of crude petroleum decreased by 11% to an average of 85,750 barrels per day (bbl/d) from 96,322 bbl/d in 2003 as a result of a 10% decrease in output from the onshore Sirikit Oilfield and a 13% decrease in output from the offshore Tantawan Oilfield. Production of condensate increased by 9% to an average of 68,390 bbl/d from 62,663 bbl/d in 2003; this was mainly the result of a 12% increase in output from the Pailin Gasfield and a 13% increase in output from the Bong Kot Gasfield. In 2004, crude petroleum was produced from 10 oilfields. The Benjamas, which was the largest offshore oilfield, was operated by Chevron Offshore (Thailand) Ltd. and produced 46.3% of the country's total. The Sirikit, which was Thailand's largest onshore oilfield, was operated by Thai Shell and produced 19.9% of the total. The Plamuk, which was Thailand's second ranked offshore oilfield, was operated by UT and produced 25.8%. The Tantawan, which was Thailand's third ranked offshore oilfield, was operated by Chevron Offshore (Thailand)

and produced 5.3% in 2004. In November 2003, Chevron Offshore (Thailand) reportedly discovered oil and gas in two exploration wells in Block 9A in the Gulf of Thailand. The company applied for a production area license for the Tantanwan 23 and the Tantanwan 24 wells. The remaining 2.7% was produced from six smaller oilfields. In 2004, about 27.9% of condensate was produced from the Pailin Gasfield; 25.9%, from the Bongkot Gasfield; 17.2%, from the Erawan Gasfield; and the remaining 29%, from seven smaller fields (Energy Policy and Planning Office, 2005a§, b§).

To meet its overall demand for crude petroleum, Thailand imported 872,300 bbl/d of crude petroleum compared with 775,900 bbl/d in 2003. Thailand's total refining capacity was 703,100 bbl/d of crude petroleum. Shell Co. of Thailand Ltd. had a 275,000-bbl/d crude capacity refinery in Map Ta Phut, Rayong Province; Thai Oil Co. Ltd. had a 192,850-bbl/d crude capacity refinery in Sriracha, Chonburi Province; Esso Standard Thailand Ltd. had a 173,500-bbl/d crude capacity refinery in Sriracha, Chonburi Province; and PTT Plc had a 61,750-bbl/d crude capacity refinery in Bang Chak, Bangkok (Oil & Gas Journal, 2002, p. 110).

In August 2004, Shell International Holding Ltd. announced that it reached a share-sell agreement to sell its entire 64% equity share in Rayong Refinery Co. Ltd. to PTT. Rayong Refinery, which has been in operation since 1996, was 64% owned by Thai Shell and 36%, by PTT (Royal Dutch Shell plc., 2004§).

Outlook

During the next 4 to 5 years, the Thai mineral sector is expected to expand and contribute more to the country's GDP because of the likely development of the Puthep copper deposit in the Province of Loei, the Udon South and the Udon North potash deposits in the Province of Udon Thani, and the Wiang Haeng coal (lignite) mine in the Province of Chiang Mai as well as development and expansion of new and existing offshore gasfields in the Gulf of Thailand. During the next 2 years, the mineral industry of Thailand is expected to continue to be dominated by the production of coal, gold, gypsum, and limestone. Thailand is expected to become the eighth ranked refined copper producer after China, Japan, the Republic of Korea, Australia, India, Indonesia, and the Philippines in Asia and the Pacific region by 2005.

Thailand's economy is forecasted to continue to grow at about the same rate as in 2004. The International Monetary Fund projects that Thailand's GDP will grow at a rate of 5.6% in 2005 and 6.2% in 2006 (International Monetary Fund, 2005§). As a result, demand for cement, steel, nonferrous metals, and mineral fuels is expected to continue to grow in 2005 and 2006 at about the same rate as that of 2004.

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Major Sources of Information

Bank of Thailand

Bangkok, Thailand

Telephone (Service Manager): 662 283 5032, 662 356 7546

Internet: http://www.bot.org.th/bothomepage/index/index_e.asp

Board of Investment of Thailand

555 Vipavadee Rabgsit Road, Bangkok, Thailand

Telephone: 66 2537 8155

Fax: 66 2537 8177

Ministry of Industry

Department of Mineral Resources

Rama VI Road, Bangkok, Thailand

Telephone: 66 2202 3667

Fax: 66 2202 3662

E-mail: Staff@dmr.go.th

Internet: <http://www.dmr.go.th>

Department of Primary Industries and Mines

Rama VI Road, Bangkok, Thailand

Telephone: 66 2202 3667

Fax: 66 2202 3662

Internet: <http://www.dpim.go.th>

Ministry of Energy

Energy Policy and Planning Office

121/1-2 Phetchaburi Road

Ratchathewi, Bangkok 10400, Thailand

Telephone: 66 2612 1555

Fax: 66 2612 1358

Internet: <http://www.eppo.go.th>

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Bank of Thailand:

Annual report, annual.

Economic report, annual.

Economic condition and economic data.

Department of Mineral Resources:
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Metal Statistics of Thailand, annual.

TABLE 1
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2000	2001	2002	2003	2004
METALS					
Antimony:					
Ore:					
Gross weight	178	40	3	83	110
Sb content	84	18	1	38	52
Metal, smelter	16	12	--	--	2
Copper, metal, refined:					
Primary	--	--	--	--	17,700
Secondary	--	--	--	--	1,900
Total	--	--	--	--	19,600
Gold kilograms	--	320	4,950	4,269	4,500
Iron and steel:					
Iron ore:					
Gross weight	100	50	570,110	9,675	135,580
Fe content ^c	50	25	285,000	4,800	68,000
Crude steel thousand metric tons	2,100	2,127	2,538	3,572	4,533
Lead:					
Ore:					
Gross weight	24,760	800	6,500	--	--
Pb content	15,600	500	3,200	--	--
Metal, refined:					
Primary	3,390	3,500	2,000	2,000	2,000
Secondary	23,803	23,000	28,000	28,000	28,000
Total	27,193	26,500	30,000	30,000	30,000
Manganese ore:					
Battery- and chemical-grade, 75% MnO ₂	225	45	--	--	--
Metallurgical-grade, 46% to 50% MnO ₂	--	--	--	--	4,550
Total, gross weight	225	45	--	--	4,550
Total Mn content ^c	110	23	--	--	2,180
Silver kilograms	--	1,159	18,018	12,496	10,700
Tantalum, metal and oxide powder	210	150	102 ^r	168 ^r	317
Tin:					
Concentrate:					
Gross weight	2,363	2,383	1,384	980	724
Sn content	1,930	1,950	1,130	793	586
Metal, primary	17,076	22,387	17,548	15,400 ^r	20,800
Tungsten concentrate:					
Gross weight	54	92	53	390	337
W content ^c	30	50	31	208	180
Zinc:					
Ore:					
Gross weight	159,093	88,664	151,876	148,297	199,477
Zn content ^c	27,000	15,300	33,600	37,100	43,400
Metal, primary	77,525	74,129	72,502	69,600	68,300
Alloy, Zn content	23,617	30,668	32,646	44,086	46,800
Zirconium concentrate, gross weight	100	--	--	--	--
INDUSTRIAL MINERALS					
Barite	56,180	23,559	137,469	115,600	211,278
Cement, hydraulic thousand metric tons	25,499	27,913	31,679	32,530	35,626
Clays:					
Ball clay	394,154	341,272	450,818	579,404	610,193
Kaolin, marketable:					
Beneficiated, washed	201,226	168,063	127,132	184,562	200,671
Nonbeneficiated, unwashed	286,912	125,133	168,883	373,811	430,364
Filler	19,836	13,520	3,150	950	--
Diatomite	390	720	780	1,288	1,372
Feldspar	542,991	710,543	783,733	824,990	1,001,053
Fluorspar, crude, metallurgical-grade	4,745	3,020	2,270	2,368	2,375

See footnotes at end of table.

TABLE 1--Continued
THAILAND: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2000	2001	2002	2003	2004
INDUSTRIAL MINERALS--Continued					
Gemstones thousand carats	928	1,071	1,597	716	911
Gypsum thousand metric tons	5,830	6,191	6,326	7,291	7,619
Mica	107	72	--	--	--
Perlite	6,000	9,915	7,600	5,700	6,000 ^e
Phosphate rock, crude	3,260	2,359	3,680	13,870	2,580
Salt:					
Rock	792,250	852,565	908,968	892,243	1,031,200
Other ^c	100,000	100,000	100,000	100,000	100,000
Sand, silica, glass	471,547	513,880	781,014	1,293,929	587,655
Stone:					
Calcite	87,100	159,050	172,760	232,025	436,628
Dolomite	625,127	871,308	933,209	865,708	992,907
Granite:					
Dimension stone cubic meters	7,595	6,659	7,597	9,866	10,000 ^e
Industrial rock thousand metric tons	2,154	2,546	3,370	3,107	3,500 ^e
Limestone:					
For cement manufacture only do.	43,492	46,984	54,214	46,868 ^r	63,196
Construction and other uses do.	37,017	40,100	56,226	66,073	70,000 ^e
Marble, dimension stone and fragment cubic meters	270,036	314,445	461,272	339,166	236,643
Marl for cement manufacture only	7,290	7,755	83,135	80,405	184,750
Quartz	5,177	48,908	32,954	65,559	19,216
Shale for cement manufacture only thousand metric tons	3,110	3,364	5,017	2,982 ^r	3,622
Talc and related materials:					
Pyrophyllite	46,011	59,602	103,496	73,556	108,691
Talc	7,390	6,838	1,702	8,501	12,592
MINERAL FUELS AND RELATED MATERIALS					
Coal, Lignite thousand metric tons	17,786	19,607	19,572	18,843 ^r	20,060
Natural gas, gross production million cubic meters	20,190	19,637	20,527	21,677 ^r	22,366
Petroleum:					
Crude thousand 42-gallon barrels	21,147	22,599	27,582	34,990 ^r	31,158
Natural gas condensate do.	19,060	18,924	19,609	23,161 ^r	25,030
Refinery products:					
Liquefied petroleum gas do.	32,511	37,067	37,069	38,872	41,520
Gasoline do.	50,862	52,376	51,896	54,342	56,339
Jet fuel do.	27,347	26,651	29,373	26,778	29,127
Kerosene do.	3,090	3,693	3,457	4,386	7,041
Distillate fuel oil do.	43,970	40,669	37,610	38,248	42,277
Residual fuel oil ^e do.	22,000	22,000	22,000	23,000	24,000
Unspecified ^{e, 2} do.	3,500	3,500	3,500	3,500	3,600
Total ³ do.	183,000	186,000	185,000	189,000	204,000 ^e

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^rRevised. -- Zero.

¹Includes data available through September 23, 2005.

²Includes refinery fuel and refinery gains or losses.

³Data are rounded to three significant digits.

Sources: Department of Mineral Resources, Mineral Statistics of Thailand; Department of Primary Industries and Mines; Ministry of Commerce, Energy Policy and Planning Office; and U.S. Geological Survey, Mineral Questionnaires, 2003-2004.

TABLE 2
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Barite		Asian Mineral Resources Co. Ltd.	Loei, Mae Hong Son, Nakhon Si Thammarat, and Satun Provinces	60
Do.		P & S Barite Mining Co. Ltd.	Loei and Nakhon Si Thammarat Province	60
Cement		Asia Cement Co. Ltd.	Pra Phutthabath, Saraburi Province	4,800
Do.		Jalaprathan Cement Co. Ltd. (Cement Francais S.A., 37%; Veatprapat Holding Co. Ltd., 19%; others, 44%)	Takli, Nakhorn, Sawarn Province; and Cha-Am, Petchburi Province	2,350
Do.		Samukee Cement Ltd.	Pakchong, Nakhon Ratchasima Province	125
Do.		Saraburi Cement Co. Ltd. (CEMEX Asia Holdings Ltd. of Mexico, 99%)	Chalerm Phrakiat, Saraburi Province	700
Do.		Siam Cement Industry Co. Ltd. (Bureau of the Crown Property, 30%; Thai Security Depository Co. Ltd., 6.94%; CPB Equity Co. Ltd., 5.6%; other financial Institutions and general public, 57.46%)	Kaeng Khoi, Phabudhabat, and Khao Wong, Saraburi Province; Chae hom, Lampang Province; Thung Song, Thammarat Province; and Ta Luang, Ayutthaya Province	23,200
Do.		Siam City Cement Co. Ltd. (Holcim Ltd. of of Switzerland, 33.7%; Ratanarak family, 27%; other investors, 39.3%)	Kaeng Khoi, Saraburi Province	14,500
Do.		TPI Polene Public Co. Ltd.	Kaeng Khoi, Saraburi Province	9,900
Coal, lignite		Electricity Generating Authority of Thailand	Mae Moh, Lampang Province; Li, and Lamphun Province	20,000
Do.		Lanna Resources Public Co. Ltd.	Baan Pa Kha, Lampang Province; and Nong Ya Plong, Petchburi Province	1,800
Copper, refined		Thai Copper Industries Co. (Thai Asset Management 40%; Thai Film Industry, 30%; Aker Kvarmer, 30%)	Rayong, Rayong Province	165
Feldspar, concentrate		Asia Mineral Processing Co. Ltd.	Provinces of Nakhon Si Thammarat and Trang	500
Fluorspar, concentrate		Asian Mineral Resources Co. Ltd.	Mae Hong Son Province	14
Gas, natural	million cubic meters per day	Esso Exploration and Production Khorat Inc.	Namphong, Khon Kaen Province	4
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot in the Gulf of Thailand	15
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Kaphong, Pladang, Satun, Pailin, Trat, all in the Gulf of Thailand	33
Gold	kilograms	Akara Mining Ltd. (Kingsgate Consolidated N.L. of Australia, 100%)	Chatree, Pichit Province	5,000
Gypsum		Thai Gysum Products Pcl. (Thaigips Holdings Ltd., 40.75%; BPB Gypsum B.V., 30%; others, 29.25%)	Nong Bau, Nakhon Sawan Province and Ban Munnak, Phichit Province	2,000
Do.		Vanich Gypsum Co. Ltd.	Khleng Prab, Mai Rieng. Thoong Yai Mai in Provinces of Nakhon Si Thammarat and Surat Thani	2,000
Lead, in concentrate		Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, Nong Phai, and Bo Ngam in Kanchanaburi Province	30
Petroleum, crude included condensate	thousand 42-gallon barrels per day	Chevron Offshore (Thailand) Ltd.	Benjamas, Tantanawan, offshore in the Gulf of Thailand	35
Do.	do.	Thai Shell Exploration and Production Co. Ltd.	Sirikit in Kamphaenghet Province	24
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot, offshore in the Gulf of Thailand	12
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Gomin, Jakrawan, Kaphong, Pailin, Platon, Satun, Surat, Trat Plamuk, offshore in the Gulf of Thailand	38
Steel, rolled		The Bangkok Iron and Steel Works Co. Ltd.	Phrapradaeng, Samutprakarn Province	120
Do.		Bangkok Steel Industry Public Co. Ltd.	do.	300
Do.		Millenium Steel Co. Ltd. (Siam Cement Public Co. Ltd., 45%; McDonald Investment, 6.5%; and other investors, 48.5%)	Provinces of Chon Buri, Muang Rayong, and Saraburi	1,700
Do.		Namheng Steel Co. Ltd.	Lopburi Province	350
Do.		Sahaviriya Group Corp. Ltd.	Bang Saphan, Prachuap Khiri Khan Province	2,400
Do.		Siam United Steel Co. Ltd.	Rayong Province	1,000
Do.		Siam Yamato Steel Co. Ltd.	Muang, Rayong Province	600

TABLE 2--Continued
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Tantalum, metal powder and oxides	metric tons	H.C. Starck (Thailand) Co. Ltd. (H.C. Starck GmbH, 94.98%, and others, 5.02%)	Map Ta Phut, Rayong Province	250
<u>Tin:</u>				
Concentrate		Numerous small companies	Nakhon Si Thammarat, Phangnga, Phuket, and Ranong Provinces	3
Refined		Thailand Smelting and Refining Co. Ltd. (Amalgamated Metal Corp., 75.25%, and other, 24.75%)	Phuket, Phuket Province	30
<u>Zinc:</u>				
In concentrate		Padaeng Industry Public Co. Ltd. (Umicore SA of Belgium, 44.77%; Ministry of Finance, 13.81%; others, 41.42%)	Mae Sot, Tak Province	65
Refined		do.	Tak, Tak Province	115